REMARKS

Applicant appreciates the Examiner's thorough consideration provided the present application. Claims 1, 2, 4, 6-14, 16, 18-25, 27, 28 and 30-38 are now present in the application. Claims 1, 13 and 24 are independent. Reconsideration of this application is respectfully requested.

Claim Rejections Under 35 U.S.C. §§ 102 & 103

Claims 1, 2, 7, 8, 10, 12-24, 20, 22-25 and 30-38 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Gustafsson et al., U.S. Patent No. 6,549,586 (hereinafter "Gustafsson"). Claims 10 and 20 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Gustafsson in view of Ozawa, U.S. Patent No. 5,774,835 (hereinafter "Ozawa"). These rejections are respectfully traversed.

Complete discussions of the Examiner's rejections are set forth in the Office Action, and are not being repeated here.

Independent claim 1 recites "receiving a distorted input signal that includes an embedded corrupting signal, wherein the embedded corrupting signal is statistically related to the undistorted sound signal", "defining an enhancement signal as the difference between the distorted input signal and the enhanced output signal, whereby the enhancement signal attempts to offset the embedded corrupting signal", "determining a power of the enhancement signal", "constraining possible values for the power of the enhancement signal based on characteristics of the distorted input signal" and "producing the enhanced output signal, based at least in part upon constrained values of the power of the enhancement signal resulting from the constraining step."

Independent claim 13 recites "receiving a distorted input signal that includes an embedded corrupting signal, wherein the embedded corrupting signal is statistically related to the undistorted sound signal", "estimating a first iteration enhanced output signal", "defining a first iteration enhancement signal as the difference between the distorted input signal and the first iteration enhanced output signal", "determining a power of the first iteration enhancement signal", "constraining possible values for the power of the first iteration enhancement signal based on characteristics of the distorted input signal" and "producing a second iteration enhanced output signal, based at least in part upon constrained values of the power of the first iteration enhancement signal resulting from the constraining step."

Independent claim 24 recites "[a] sound enhancement system that improves a distorted input signal to produce an enhanced output signal where the distorted input signal includes an embedded corrupting signal, wherein the embedded corrupting signal is statistically related to an undistorted sound signal", "an enhancement circuit that receives the distorted input signal and produces a first iteration enhanced output signal, wherein the enhancement circuit: defines the first iteration enhancement signal as the difference between the first iteration enhanced output signal and the distorted input signal; determines a power of the first iteration enhancement signal; and constrains possible values for the power of the first iteration enhancement signal based on characteristics of the distorted input signal", "a feedback circuit that feeds back the first iteration enhancement signal as an improved distorted input signal to effect production of a second iteration enhanced output signal by the enhancement circuit" and "an output circuit that produces the enhanced output signal upon completion of at least one iteration cycle."

Applicant respectfully submits that the combinations of steps set forth in claims 1 and 13 and the combination of elements as set forth in claim 24 are not disclosed or suggested by the references relied on by the Examiner.

The Examiner alleged that Gustafsson disclosing receiving a distorted input signal that includes an embedded corrupting signal which is statistically related to the undistorted sound signal as recited in claims 1, 13 and 24. Applicant respectfully disagrees. In fact, the standard assumption in the field of noise suppression is that the noise is independent of the clean-speech signal. Gustafsson also clearly makes this assumption in col. 3, lines 36-40. The present invention is aimed at situations where the clean-speech signal and the noise signal are not uncorrelated, which is significantly different from Gustafsson's assumption that the speech signal and the noise signal are random and uncorrelated. Therefore, it is improper to use Gustafsson against the present application because the distorted input signal x(n) does not include any noise signal w(n) which is statistically related to the undistorted sound signal s(n) as recited in claims 1, 13 and 24.

The Examiner referred to the noise power spectral density $|W_N(f_u)|$ as the enhancement signal of claims 1, 13 and 24. Again, Applicant respectfully disagrees. Gustafsson discloses that the noise power spectral density $|W_N(f_u)|$ is the difference between the distorted signal power spectral density $|X_N(f_u)|$ and the undistorted signal power spectral density $|S_N(f_u)|$ (see Equation (7)). In other words, the term $|W_N(f_u)|$ is simply the difference of the power spectral density between the distorted signal power spectral density and the undistorted signal power spectral density, not the difference between the distorted signal and the undistorted signal either in the time-domain or the frequency-domain (i.e., Fourier transform). Gustafsson, like other

conventional enhancement methods, fails to teach calculating the difference for the time-domain signal, or its Fourier transform. Gustafsson does not refer to the term $|W_N(f_u)|$ as a signal but as a spectral density because it is bereft of phase. Accordingly, the term $|W_N(f_u)|$ does not provide a complete description of an audio signal, and cannot correspond to the difference of the enhanced output signal and the distorted signal as recited in claims 1, 13 and 24. As a result, the enhanced signal of Gustafsson is simply a scaled version of the distorted signal.

Unlike Gustafsson, the present invention does not simply operate based on a simple scaling of the distorted signal. In the context of the present invention, which is aimed at enhancing the spectral fine structure (as opposed to the spectral envelope), the effect of the phase is important and clearly audible. For example, the only difference between whispered speech and voiced speech is in the phase (assuming conventional pitch-synchronous spectra). Gustafsson's method would not work because there is no difference in the power spectral density (*i.e.*, the power spectral density $|W_N(f_u)|$ is zero) and Gustafsson's bereft-of-phase method cannot offset any phase difference. Unlike Gustafsson, since the enhancement signal is an audio signal with phase, the enhancement signal can be used to offset the phase difference. This feature is clearly absent from Gustafsson.

The Examiner also alleged that the use of the parameter k in Gustafsson corresponds to constraining possible values for the power of the enhancement signal based on characteristics of the distorted input signal as recited in claims 1, 13 and 24. Again, Applicant respectfully disagrees.

Applicant respectfully submits that a constraint is a bound on a variable or mathematical expression. Gustafsson discloses that the parameter k of Gustafsson is simply used to "control

the amount of noise suppression" (see col. 4, lines 18-19). Gustafsson in col. 13, lines 13-15 discloses that the parameter k can be based on the input SNR of the microphones. This amounts to an ad-hoc mapping of SNR to the parameter k. If the value of the parameter k (which is nonnegative) is reduced, it simply scales down the term $k|W_N(f_u)|^a$ in Equation (9) of Gustafsson. In other words, it simply reduces the frequency with which this term has large energy. However, it does not prevent large energies from occurring. This may result in occasional audible distortions.

In contrast, the constraint in the present invention prevents large energy values of the enhancement signal; *i.e.,* large energy values of the enhancement signal are simply not possible. This can prevent annoying audible artifacts. On the other hand, Gustafsson will reduce the energy of $k|W_N(f_u)|^a$ even when it is small, whereas in the present invention the enhancement signal is not affected. In other words, Gustafsson simply disclosing scaling, which cannot prevent large energies from occurring. Unlike Gustafsson, the present invention constrains to prevent the large energy values of the enhancement signal, and therefore allows strong enhancement without annoying audible artifacts. This feature is clearly absent from Gustafsson.

With regard to the Examiner's reliance on Ozawa, this reference has only been relied on for its teachings related to the subject matter of dependent claims. This reference also fails to disclose the above combinations of steps and elements as set forth in independent claims 1, 13 and 24. Accordingly, this reference fails to cure the deficiencies of Gustafsson.

Accordingly, neither Gustafsson nor Ozawa individually or in combination teaches or suggests the limitations of independent claims 1, 13 and 24. Therefore, Applicant respectfully

submits that independent claims 1, 13 and 24 clearly define over the teachings of the utilized references.

In addition, claims 2, 4, 6-12, 14, 16, 18-23, 25, 27, 28 and 30-38 depend, either directly or indirectly, from independent claims 1, 13 and 24, and are therefore allowable based on their respective dependence from independent claims 1, 13 and 24, which are believed to be allowable.

In view of the above remarks, Applicant respectfully submits that claims 1, 2, 4, 6-14, 16, 18-25, 27, 28 and 30-38 clearly define the present invention over the references relied on by the Examiner. Accordingly, reconsideration and withdrawal of the rejections under 35 U.S.C. §§ 102 and 103 are respectfully requested.

CONCLUSION

All the stated grounds of rejection have been properly traversed and/or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider all presently pending rejections and that they be withdrawn.

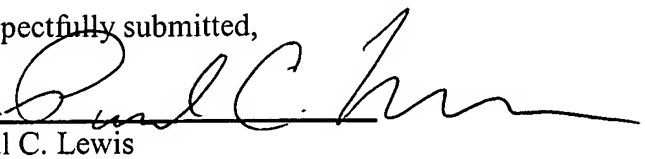
It is believed that a full and complete response has been made to the Office Action, and that as such, the Examiner is respectfully requested to send the application to Issue.

In the event there are any matters remaining in this application, the Examiner is invited to contact the undersigned at (703) 205-8000 in the Washington, D.C. area.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

Dated: February 28, 2006

Respectfully submitted,

By 

Paul C. Lewis
Registration No.: 43,368
BIRCH, STEWART, KOLASCH & BIRCH, LLP
8110 Gatehouse Road
Suite 100 East
P.O. Box 747
Falls Church, Virginia 22040-0747
(703) 205-8000
Attorney for Applicant